

## Compact Multi-Spectral Photometer for Space Science - COMPASS

Completed Technology Project (2015 - 2017)



## Project Introduction

Space-based vacuum ultraviolet (VUV) monitoring of planetary ionospheres has provided a foundational means to monitor and understand the key transition from neutral gas to plasma-dominated physical regimes in the Earth's thermosphere. Operational VUV spectrographs, such as GUVI on the TIMED mission, the recently selected Explorer-class ICON and GOLD missions, and a series of DoD DMSP satellites, have provided and should continue to provide pioneering discoveries of dayside composition, auroral energetics, and nightside RF-disruptive phenomena. Unfortunately, new mission opportunities for costly research-class VUV spectrographs are relatively rare and the resultant handful of satellites provide limited local-time and revisit-time coverage of regional ionospheric features. This proposal addresses the recommendation in the National Research Council's 2012 Decadal Strategy for Solar and Space Physics for 'small space missions' to diversify space physics research - by developing the Compact Multi-Spectral Photometer for Space Science (COMPASS), a nanosatellite-scale narrowband UV photometer specifically tailored for the resource constraints of the modern 3U CubeSat standard. COMPASS is optimized for oxygen and nitrogen VUV emissions that can provide future constellation missions with a low-resource sensor for global, multi-point, and trans-hemispheric thermospheric investigations of key dayside, auroral, and nightside geophysical regimes. Future mission implementations could include COMPASS tuned for simultaneous N<sub>2</sub> Lyman-Birge-Hopfield (LBH) band emissions and O 135.6-nm emissions to target observations such as storm-modulated composition and waves on the dayside, auroral energy deposition and conductance at high latitudes, and disruptive ionospheric structures at polar cap, mid- and low-latitudes, such as polar patches and equatorial plasma bubbles. The COMPASS notional design, comprised of elements from TRL 3 to 5, is a dual-channel photometer that implements prior flight technology developments in thin film reflective coatings, compact (CubeSat-scale) electronics packaging, and high heritage photometric detectors. Specifically, COMPASS benefits from prior design and flight of the USAF CubeSat Tiny Ionospheric Photometer (i.e. high sensitivity CsI-based detector, CubeSat-scale high-voltage and readout electronics) and of NASA's Polar satellite UV Imager (narrowband VUV-coated optics). Herein, we propose to build a COMPASS prototype (along with several narrow-band filters samples) and execute a technology maturation plan via a series of rigorous tests and photometric evaluations in relevant thermal/vacuum, launch vibration, and pre-launch humidity environments. In doing so, we will bring the integrated COMPASS prototype to a TRL 6 status at the conclusion of 2 years with sufficient system engineering, safety, and mission assurance documentation to satisfy full readiness for operational CubeSat mission integration.



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## Organizational Responsibility

### Responsible Mission Directorate:

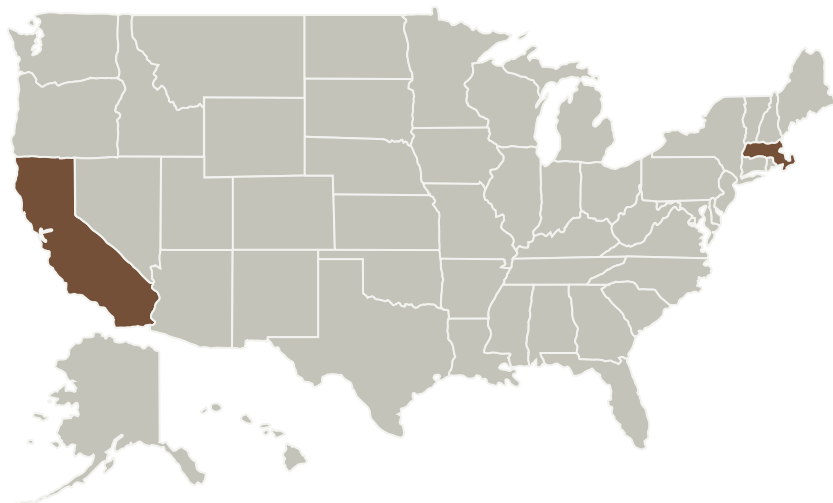
Science Mission Directorate  
(SMD)

### Responsible Program:

Heliophysics Technology and  
Instrument Development for  
Science



## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of California-Berkeley(Berkeley)	Supporting Organization	Academia	Berkeley, California

Primary U.S. Work Locations	
California	Massachusetts

## Project Management

**Program Director:**

Roshanak Hakimzadeh

**Program Manager:**

Roshanak Hakimzadeh

**Principal Investigator:**

Harald U Frey

**Co-Investigators:**

John Noto

Joyce So

Richard A Doe

## Technology Areas

**Primary:**

- TX08 Sensors and Instruments
  - └ TX08.3 In-Situ Instruments and Sensors
    - └ TX08.3.6 Extreme Environments Related to Critical System Health Management

## Target Destination

The Sun